DOCUMENT RESUME

ED 467 855

JC 020 590

AUTHOR	Chang, June C.
TITLE	Women and Minorities in the Science, Mathematics and Engineering Pipeline. ERIC Digest.
INSTITUTION	ERIC Clearinghouse for Community Colleges, Los Angeles, CA.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	EDO-JC-02-06
PUB DATE	2002-06-00
NOTE	4p.
CONTRACT	ED-99-CO-0010
AVAILABLE FROM	For full text: http://www.gseis.ucla.edu/ERIC/ digests.html. Tel: 800-832-8256 (Toll Free).
PUB TYPE	ERIC Publications (071) -- ERIC Digests in Full Text (073)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	*Mathematics; Academic Persistence; Community Colleges; *Engineering; Ethnic Groups; *Females; Gender Issues; Job Training; *Minority Groups; Outcomes of Education; School Holding Power; Sciences; Two Year College Students; Two Year Colleges
IDENTIFIERS	ERIC Digests

ABSTRACT

Over the next ten years, the United States will need to train an additional 1.9 million workers in the sciences. Increased participation of women and minorities is essential in meeting the projected need for Science, Mathematics, and Engineering (SME) workers. Women, who received 56% of B.A.'s overall, comprised 37% of the SME bachelor degrees conferred in 1998, while underrepresented minorities received just 12% of SME degrees awarded. A recent national study examining trends in undergraduate education reveals a steady decline in student interest in the physical sciences and mathematics over the last 30 years. African-Americans, Latinos, and Native Americans possess strong cultural values of group and community membership that may be at odds with the perceived levels of individualism and competition associated with the sciences. For women, perceptions of competition and difficulty with majoring in the sciences are paired with low self-ratings of ability in analytical fields that have traditionally been male-dominated. There are also retention issues that must be addressed. Approximately 50% of students entering college with the intention of majoring in SME change majors within the first two years. This digest reports on some of the innovative programs that are being developed in order to address these problems. Contains 12 references. (NB)

Reproductions supplied by EDRS are the best that can be made

ED 467 855

Women and Minorities in the Science, Mathematics and Engineering Pipeline

ERIC Digest

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

June C. Chang
ERIC Clearinghouse for Community Colleges

BEST COPY AVAILABLE

ERIC
Educational Resources Information Center

Clearinghouse for Community Colleges

Digest

June, 2002

EDO-JC-02-06

Women and Minorities in the Science, Mathematics and Engineering Pipeline

By June C. Chang

Over the next 10 years, the United States will need to train and educate an additional 1.9 million workers in the sciences (NSB, 2002). Recent enrollment trends indicate that increased involvement of underrepresented groups is essential in meeting this demand. Currently, all along the educational pipeline, students are being lost in the fields of science, mathematics and engineering (SME). Moreover, the participation and persistence rates of women and minorities in these fields are dramatically lower than those of the general student population. In 1998, women who received 56 percent of BAs overall comprised 37% of the SME bachelor degrees conferred, and underrepresented minorities, including African-Americans, Latinos, and Native Americans, received just 12% of the total SME degrees awarded (NSB, 2002).

Community colleges have been called upon to help bolster underrepresented student participation in these fields (Feuers, 1990; NSF, 1996). Two-year colleges enroll nearly half of all undergraduate students. Women slightly outnumber men at these campuses, and over fifty percent of ethnic minorities in higher education attend a community college. As many of these underrepresented students have their first exposure to higher education SME at these institutions, community colleges possess a special responsibility and influence in moving participants through the pipeline. This digest discusses SME interest barriers and strategies for retaining women and minorities in SME, examining how community colleges are working to promote increased representation and success of women and minorities in SME.

Factors Affecting Interest in the Sciences

Student interest in SME fields continues to decrease. A recent national study examining trends in undergraduate education reveals a steady decline in student interest in the physical sciences and mathematics over the last thirty years (Astin, Parrott, Korn, Sax, 1997). Of those students who enter showing an interest in SME, certain academic factors are found in common. These include: earning high SAT math scores and high school GPAs and having previously taken courses in science and mathematics (Seymour, 1992). In addition, students in SME at community colleges also tend to be enrolled full-time, have higher academic aspirations than their peers, and have a greater interest in transferring to four-year institutions (Feuers, 1990).

After accounting for these factors, however, minorities and women still appear to have a lower level of interest in the sciences (NSB, 2002). Research indicates that attitudinal factors contribute to the discrepancy. African-Americans, Native Americans, and Latinos possess strong cultural values of group and community membership that may be at odds with the perceived levels of individualism and competition associated with the sciences (NSF, 1996). They also report a lack of interaction with current participants in SME fields, which is a barrier to increased interest. For women, perceptions of competition and difficulty with majoring in the sciences are paired with low self-ratings of ability in analytical fields that have traditionally been male-dominated. Cases of math anxiety and instructors' lowered expectations have also been shown to hinder women from participating (Seymour and Hewitt, 1997).

To reverse these perceptions and increase female and minority participation, educators point to the need to strengthen the educational pipeline, especially at the pre-college and community college level where interest in mathematics and science develops. To this end, community colleges have partnered with elementary and secondary schools. The Mathematics, Engineering, Science, and Achievement (MESA) program, which partners Glendale Community College with local high school classes, is an example of such an approach (Mendoza, 1991). Evaluations of similar programs at Broward Community College and Delgado Community College reveal high levels of persistence in these programs as well as increased women and minority student interest in science and technology (Green, Blasik, Hartshorn, Shatten-Jones, 2000).

Challenges in Retaining Students

In addition to the challenges of recruiting students as SME majors, there are also retention issues. These three fields report the lowest retention rates among all academic disciplines. Approximately 50% of students entering college with an intention to major in SME change majors within the first two years (Center for Institutional Data Exchange and Analysis, 2000).

One reason for this loss of students is that many incoming freshmen lack basic science and mathematics literacy needed for persistence. A study conducted at twenty-three community colleges in California found that 31% of students fail to complete SME courses, while another 19% complete courses but with a grade of D or F (Feuers, 1990). Not only is the course completion rate particularly low in SME fields, but the percentage of students requiring remedial work is also increasing, approximately one-third of students at two-year colleges enroll in remedial mathematics courses (NSB, 2002). These courses are essential for responding to students' lack of readiness for college level SME coursework. Especially in urban community colleges that serve a large minority population from low performing high schools, intensive programs in remedial education are important for increasing

minority student retention in SME (Feuers, 1990).

While deficiencies in students' academic preparation lead to attrition, research suggests that students' negative perceptions of SME subject material and career options also play an important role. In a survey of college students who left SME, the most frequently cited factors contributing to decisions to change majors included: the belief that non-SME majors offer greater intrinsic interest, a loss of interest in SME, and a rejection of the SME career-associated lifestyle (Seymour, 1992).

Farrell (2002) explains that SME fields have failed to highlight the social value and relevance of the subject material. In particular, the disconnection between subject material and life applicability has been shown to affect the retention of women in engineering. For many female students, the technical nature of engineering does not suggest life skills of creative thinking and communication. Seymour (1992) explains that the image of scientific careers also does not appeal to female students' orientation toward helping others and having a family.

Innovations in Retaining Underrepresented Students

Community colleges have employed several approaches to increase retention of women and minorities in SME. First, efforts have been taken to address the perceived lack of relevance of coursework. The National Science Board (2002) recommends restructuring undergraduate SME curriculum to include more investigative learning, technology, laboratory experience, and collaborative work. Programs that have provided students an opportunity to engage in hands-on, real life projects have been successful in increasing female enrollment and retention (Farrell, 2002). Changing the curriculum to promote more collaborative group work has also helped students develop peer networks. Such social support systems are of particular benefit to underrepresented students in fields that have previously been perceived as intimidating or unwelcoming (Farrell, 2002).

Mentoring programs that help socialize students to SME fields are another form of support for women and minorities. The presence and guidance of peer or faculty mentors have been shown to positively affect retention (NSF, 1996). For women in the sciences, mentors help provide a support network that increases students' self-confidence and feeling of worth to the field (Goodman Research Group, 2002).

Lastly, two-year colleges are seeking not only to increase retention, but also to increase transfer of underrepresented students. Currently, over 35% of ethnic minorities graduating with a bachelor's degree in science and engineering began their college careers at community colleges (NSF, 1996). To increase these numbers, partnerships between two- and four-year colleges have been established. Programs like the Community College Summer Research Program at Occidental College have successfully transferred groups of students who have later gone on to pursue SME study (Halleck, 1990).

Conclusion

Increased participation of women and minorities is essential in meeting the projected need for SME workers, and in furthering the nation's production of technology and scientific research. The community college, with its diverse student population, is an integral player in advancing underrepresented student involvement in the sciences. At these institutions, steps need to continue to be taken to reduce social and educational barriers and encourage students to pursue and persist in SME.

References

Astin, A. W., Parrott, S. A., Korn, W. S. & Sax, L. J. (1997). *The American freshman: Thirty-year trends.* Los Angeles: Higher Education Research Institute, UCLA.

Center for Institutional Data Exchange and Analysis. (2000). *1999-2000 SMET retention report.* Norman, OK: University of Oklahoma.

Farrell, E. F. (2002). Engineering a warmer welcome for female students. *The Chronicle of Higher Education, 48,* A31.

Feuers, S. (1990). Student participation in mathematics and science programs. In D. P. Gallon (Eds.), *Regaining the edge in urban education: Mathematics and sciences.* Washington, DC: American Association of Community and Junior Colleges. (ERIC Document Reproduction Number ED341450).

Green, L. R., Blasik, K., Hartshorn, K., Shatten-Jones, E. (2000). Closing the achievement gap in science: A program to encourage minority and female students to participate and succeed. *ERS Spectrum, 18,* 3-13.

Goodman Research Group (2002). Final report of the women's experiences in college engineering (WECE) project. Cambridge, MA: Author.

Halleck, D. (1990). Breaking Down Barriers for Women and Minorities in Mathematics and Sciences. In *Regaining the Edge in Urban Education Mathematics and Sciences.* D. P. Gallon (Eds.). Washington DC: American Association of Community and Junior Colleges. (ERIC Document Reproduction Number ED341450).

Mendoza, J. (1991). *Mathematics, engineering, science, and achievement: Pre-college program for minority students.* (ERIC Document Reproduction Number ED339433).

National Science Foundation. (1996). *Women, minorities, and persons with disabilities in science and engineering: 1996,* (Report No. NSF 96-311). Arlington, VA: Author. (ERIC Document Reproduction Number ED402192).

National Science Board (2002). *Science and engineering indicators – 2002,* (Report No. NSB-02-1). Arlington, VA: Author.

Seymour, E. (1992). "The Problem Iceberg" in science, mathematics, and engineering education: Student explanations for high attrition rates. *Journal of College Science Teaching, February,* 230-238.

Seymour, E. & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview Press.

This project has been funded at least in part with Federal funds from the U.S. Department of Education under contract number ED-99-CO-0010. The content of this publication does not necessarily reflect the views or policies of the U.S. Department of Education nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

NOTICE

Reproduction Basis

☐ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☑ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").